

## ***Interactive comment on “Trend analysis of tropospheric***

***NO<sub>2</sub> column density over East Asia during 2000 – 2010 : multi –***

***satellite observations and model simulations with the updated F***

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Received and published: 21 June 2013

This study analyzed tropospheric NO<sub>2</sub> trends over East Asia during 2000-2010, using observations from satellite instruments and regional model simulations with an updated emission inventory. Understanding trends in Asian NO<sub>x</sub> emission during the past 20 years or so and the cause of biases between the bottom up emission inventory and satellite retrievals is an active research area. I believe that the most valuable aspect of this study is conducting regional-scale, full-chemistry model simulations at 80x80

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km horizontal resolution for a decade. The authors could have taken advantage of this unique model experiments and conduct in-depth analysis. This study is certainly within the scope of ACP but the manuscript needs to go through major revisions before it can be published in ACP.

Major limitations of this work include: 1) Most discussions on the uncertainty of satellite measurements and model results in the current version of the manuscript are vague, i.e. mostly repeating the points already addressed in previous work and lacking a clear focus relevant to this particular model (CMAQ). 2) Different trends in morning (GOME and SCIAMACHY) versus afternoon (OMI) measurements (Page 11256 and 11257) need to be better visualized in the figure and discussed in light of the role of emissions versus lifetime. Does the model reproduce the morning versus afternoon difference? 3) The major limitation of the model set up is the exclusion of lightning NO<sub>x</sub> emissions, which may contribute a substantial portion to tropospheric column NO<sub>2</sub> in some regions over East Asia. 4) Averaging kernel has not been applied in the current model evaluation. Will the application of averaging kernel reduce the wintertime biases?

Specific comments: 1. Title: The title of the manuscript need be concise and as short as possible. I think the current title of manuscript is really too long and somewhat confusing.

Suggested title: Tropospheric NO<sub>2</sub> trends over East Asia during 2000-2010: satellite observations and regional model analysis

2. Abstract: Discussion of the trends needs to be quantitative. It would be much stronger if you add numbers (e.g. xx% per year) after "Rapid growth" and "Slightly decreasing"

3. Line 14, Page 11250: "Temporal variation, and interannual trends of NO<sub>x</sub> emissions" is awkward because temporal variation on daily to seasonal time scales in NO<sub>2</sub> VCD can reflect changes in NO<sub>2</sub> lifetime rather than in emissions. Maybe revised to "long-

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term trends of NO<sub>x</sub> emissions"?

4. Line 23, Page 11250, "the anthropogenic emissions would have underestimate the growth in NO<sub>x</sub> emissions " is odd. Change "the anthropogenic emissions" to "the bottom up emission inventory"?

5. Line 25, Page 11255, "the model reproduced the temporal variation in ...". Do you mean "spatial variation"?

6. Line 7-10, Page 11256, Where do you see this?

7. Line 15-18, Page 11257, Clarify what exactly Han et al (2009) found by comparing multiple emission inventory?

8. Table 1: the time period and pixel size of OMI and GOME2 are wrong

9. Figures: Throughout the discussion, it is difficult to follow which figure you are referring to in the text. The panels in the figures need to be clearly labeled using alphabet letters and referred in the text.

10. Figure X: Wouldn't the NO<sub>2</sub> variability during 2000-2003 for Korea is an artifact of measurement noise due to a small sampling domain?

11. Can you also discuss how emission trends in the updated REAS inventory compare with trends in other inventories? This can be very helpful to those who are interested in applying the the REAS inventory in model simulations.

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 11247, 2013.

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